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APPLE JUICE, 1940 MODEL

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We hear a lot about the average man, the average income, the average yield of crops. This hypothetical average thing does not perhaps exist but it typifies a large group. We thought it would be instructive to find out what the average packed apple juice looks like and tastes like and how it was made. Therefore, the National Apple Institute, in cooperation with the Eastern Regional Research Laboratory, undertook to make a survey of the apple juice packed in the United States in 1940.

Some of the points we hoped to determine were the following:

1. To obtain a cross section of the methods in use and of the quality of juice produced.
2. To determine what makes a good or a poor apple juice.
3. To learn how much is packed and how much could be packed with present equipment.
4. To obtain data which might help in establishing standards.

From the container manufacturers we obtained the names of the packers of apple juice. Dr. Marshall, of the Michigan Agricultural Experiment Station, also supplied some. We may have missed a few but the names of 83 packers in all were obtained. Some of them did not pack in 1940; some had no juice left at the time we wrote; and 15 failed to reply. We finally wound up with 60 samples from 52 companies, including samples from some of the experiment stations and from our own experimental work. The samples represented the whole country. There were 15 plants in New England and New York, 11 in the Atlantic States, 13 in the Middle West, and 11 in the far West. It should be kept in mind in the following discussion that there may have been a tendency for the packer to ship us his better juice since no one packer has the same quality throughout.

Each packer was sent a questionnaire and each was assigned a confidential code number so that he could recognize his sample in any published results of the survey. This questionnaire called for information on the varieties of apples used; the kind of storage; the type of clarification, if any; the temperature and time of pasteurization; whether deaeration was employed; the 1940 production in gallons; and the capacity of the plant in terms of an 8-hour day and 26-day month. The replies were very complete and detailed and we thoroughly appreciate the cooperation of the packers in this respect.

The samples averaged about six months old when received. When they were all in, they were subjected to analysis for specific gravity (Brix), acidity, tannin, color, and volatile flavoring constituents.

Then we got together a judging committee consisting of: Mr. C. A. Greenleaf, National Cannors Association; Dr. Carl S. Pederson, Geneva

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Experiment Station; Mr. C. F. Schmidt, Crown Can Company; and Mr. Roy Stover, of the Owens-Illinois Glass Company. Besides these, four from the Regional Laboratory judged all of the samples. Thus, there were from 5 to 9 opinions on the flavor quality of each sample and all of the judges were familiar with packed apple juice. In order to obtain information as to how results by the Agricultural Marketing Service's proposed system of judging would compare with individual opinions of these samples, Mr. H. S. Stamp and Mr. R. H. von Glahn, of that Service, kindly gave their help. We greatly appreciate the work of all these men because it is no simple matter to taste critically 60 samples of apple juice in one day.

Up to the present time all the chemical tests have not been finished, and therefore no mathematical study has been made of the results. However the tabulations so far made enable us to draw a rather interesting picture of the apple juice industry and that is what will be attempted here.

In the table are given the salient facts without any attempt to present detailed data. The following discussion deals with the data in the table and with others not given here.

Our rating on flavor will be discussed in detail later. Suffice it to say here that the scale assigned was from 1 to 5, 5 being the very best. Only one sample graded 5; 17 graded 4; half of all the samples graded 3, and 10 graded 2. None was assigned a grade of 1. A good many individuals found samples that they graded 1 but we give here only the average of all opinions.

As to containers, about half of the packers used enameled tin and of the rest about equal numbers used glass and plain tin.

The majority of packers used apples from common storage; a few used fresh apples; and the others, cold storage. We believe that this information refers only to the samples submitted since any one company at one part of the season or another might use apples from various sources.

Thirty-five packers produced clarified juice; 27 did not clarify; of the 35 who did, 23 used the enzyme process.

Pasteurization temperatures varied from 150 to 205°F., in the majority of cases being 180 to 190°F. Time of exposure to a given temperature affects pasteurization results, of course.

The acidity varied from 0.3 to 0.8%. In three-fourths of all the samples, it fell between 0.4 and 0.6%.

The Brix hydrometer readings varied from 11.2 to 16.1, with an average of 13.5. Although we naturally expect that juice of high Brix is going to have better flavor than one of low Brix, this is not borne out in this survey, as will be discussed later.

Only 10 packers donated their juice, while 42 did not.

Over half of the samples had a tannin content below 0.01%. One was up to 0.04% and it was a very poor juice.

Thirty-three varieties of apples were represented in the samples. Those used most often were Baldwin and Red Delicious; then Jonathan and Northern Spy; then Greening, Stayman and Rome. These merely indicate the most frequently used varieties and not necessarily the relative proportions used in the blends.

The total pack represented in this survey was 4,400,000 gallons. If we consider the companies who did not reply and if we consider the juice which is not packed but sold at roadside stands, we can safely consider that from 5 to 6 million gallons of apple juice were made in 1940.

Fourteen companies in our list made over 100,000 gallons each, including two which made 500,000 each. These 14 companies made 85% of the total juice represented in this survey.

Of the total gallons packed in 1940, 25% were in plain tin, 38% in glass, and 37% in enameled tin.

The capacity of the plants per month of 26 days of 8 hours varied from 1,500 gallons to 260,000 gallons with an average of 70,000. The average calculated length of run was 6 weeks. The actual runs were probably less than this because of operating more than 8 hours per day and during more than 26 days per month. The figures undoubtedly indicate that production could be doubled by working a longer day and a longer season. We are not arguing that the production should be doubled; we merely mention this since the whole country is very conscious now of our capacity to produce all sorts of commodities.

We feel we can now describe the typical average packed apple juice of 1940. This juice was made from a blend of Baldwin, Red Delicious, Jonathan, Northern Spy, and Winesap apples taken from common storage. The Brix is 13.5; the acidity, 0.5%; the tannin, 0.01%. It is a clarified juice produced by enzyme treatment. It was not deaerated. It was pasteurized at 185°. It was filled into 20-ounce enameled cans. After 6 months of storage life, it is weak in typical apple flavor in our judgement. The plant that made this juice had a capacity of 70,000 gallons per month and it made 100,000 gallons of juice.

In our opinion the flavor of an apple juice is its all-important characteristic. There is no point in trying to sell an apple juice on the basis of its nutritive value, or whether it was clarified or unclarified, or by virtue of its pretty label, unless that juice is definitely appealing to the taste. We hold this opinion so strongly that in this survey we have tried to interpret all items considered in terms of the flavor of that juice. We set up a score card of our own with various headings. The first of these was "typical apple flavor" and the samples were rated from 1 to 5. We realized that it would be important to detect if possible what was the cause of low flavor value. We therefore set up five other headings under "off-flavor" for the judges to use. These were "green-fruit," "decayed-fruit," "metallic," "cooked," and "other." The judges agreed very well in their relative rating of typical apple flavor. They did not agree at all well in picking out the item which would explain off-flavors or poor flavors. A sour taste in some cases would be ascribed to green apples and in others, would be described as a metallic flavor. In several cases, undoubted metallic flavor occurred in samples packed in glass, indicating that the juice picked up the metal from the equipment.

For a moment let us consider only those samples which rated 4 or 5 in typical apple flavor. The majority of these were in glass or enameled tin. Only 2 were in plain tin. This would indicate some advantage in using glass or enameled tin. One-half of them were clarified and one-half were not clarified, indicating that this item makes no difference, so far as these samples are concerned. Although the temperature of pasteurization varied from 165 to 190°F., in 80% of the cases 180 to 190°F. was used, indicative that this may be the most favorable temperature for pasteurization. Since time is a factor, apparently any temperature is satisfactory so long as it is just sufficient to sterilize in the time allowed. Most of these samples had an acidity of 0.5%, indicating that probably very high or very low acidities are not desirable. All ranges of Brix were found among these samples. Denaturation apparently was not a factor, and neither was the tannin content.

Now let us consider those samples which rated 2, of which there were 10. In most cases, the judges found some decided off-flavor but they were not consistent as to what they thought that off-flavor was due to. Type of container showed nothing -- 4 glass; 4 enameled tin; 2 plain tin. Seven were clarified and 3 were not; 4 were denaturated and 6 were not. We would hesitate to conclude, however, that clarification or failure to denature were the causes of the low-flavor values.

In other words, no one of the items studied explains good or poor juice. Please bear in mind that these were judged entirely on their typical apple flavor, ignoring appearance, clarity, freedom from defects and color. Typical apple flavor, therefore, cannot always be attained by choosing one type of container or adopting a particular temperature of pasteurization or meeting a certain acidity or Brix. What is left then to explain this great difference in quality? We believe the all-important item is the quality of the apples in the first place. If we use poor apples, we can't possibly choose a particular container or a pasteurizing temperature, or employ clarification or denaturation, and thereby get a good juice of typical apple flavor. This is just common sense and should be obvious. It wasn't discovered by means of this survey. The latter merely clinches the argument. Ten or 15 years ago there was the same difference in quality in tomato juice. This difference does not obtain now. The reason is that the tomato juice packers have become meticulous as to the ripeness and soundness of their fruit and the quickness of their processing, and are employing all the tricks of processing that have been discovered by technologic research. The same holds true for grapefruit, orange juice, and pineapple juice. A common term in the apple industry is "cider grade" and this grade is far down the line in quality. It implies that any old fruit is good enough to put into cider or apple juice. This cannot possibly be the case. If we are to learn anything from the success of these other fruit juices, it is that we must put good apples into the press if we expect to get good juice out of it. And it is our firm conviction that apple juice will never become big business and have general public acceptance as long as mediocre or poor juice is put on the market.

We would expect that the bigger companies who can employ chemists to control their processes would be able to put out better quality of juice than the smaller companies without this technical help. This does not seem to be the case in the present survey. Among the 14 companies who made over 100,000 gallons, the juice of three of them rated

only 2. These companies might know how to make good juice but it is obvious that they don't make it.

When it comes to setting up standards for packed apple juice, our thesis is that typical apple flavor should be allowed somewhere between 60 and 80 points out of a possible 100, leaving color and defects to minor consideration. We will not attempt to discuss further our suggested standards. We merely want to register our belief that flavor is so important that it should be given major consideration.

We realize that most of the above discussion is along negative lines. Somebody is going to ask what process we would recommend, assuming that we start with good quality apples. We have some general suggestions based partly on the facts learned from this survey, partly on experimental evidence obtained in various places. In the first place, we must start with good apples. They may be small but they should be sound and ripe. A blend is always better than a single variety. It is futile to recommend a particular blend because any packer has to use the varieties available in his neighborhood. After the juice is pressed, it may be clarified or not. Both kinds apparently can be of good quality. A good deal depends on consumers' preferences within a particular region. If the juice is to be clarified, the enzyme process probably leaves better color and flavor in the juice than does the gelatin-tannin process but it costs more. Centrifuging for the production of a cloudy juice is very satisfactory. It enables the juice to be handled very promptly. Deaeration should probably be employed if plain tin is to be used; otherwise there does not seem to be much gained by deaerating. Apparently the type of container is not important. Glass is satisfactory beyond question since it is inert and cannot affect the juice. However, breakage and weight have to be considered. The juice should be flash-pasteurized at 180 to 190°F. for a few seconds and filled into the cans at this temperature; the cans should be inverted for 2 or 3 minutes, and then cooled quickly.

May we close with a quotation from L. L. Newcomer who discusses in a recent fruit publication the experience of a fruit cooperative in producing and marketing apple juice. It is this: "One very consoling thing has been learned and that is that the public seems to welcome a good apple drink and that production and not distribution will be our greatest problem."

Table
Summary of Apple Juice Survey

		Out of 60 samples
Typical apple flavor rating		
Grade 5 (highest)		1
" 4		17
" 3		31
" 2		10
Container		
Glass		15
Plain tin		13
Enameled tin		31
Storage		
Cold		13
Common		38
Fresh		6
Clarified		35
Enzyme treatment		23
Gelatin-tannin method		6
Heat		4
Centrifuge		2
Deaerated		10
Not deaerated		47